Lesson 1.1: Anatomy of a Payment

Module 1: The Cost Problem

Prof. Dr. Joerg Osterrieder

Digital Finance — BSc Course

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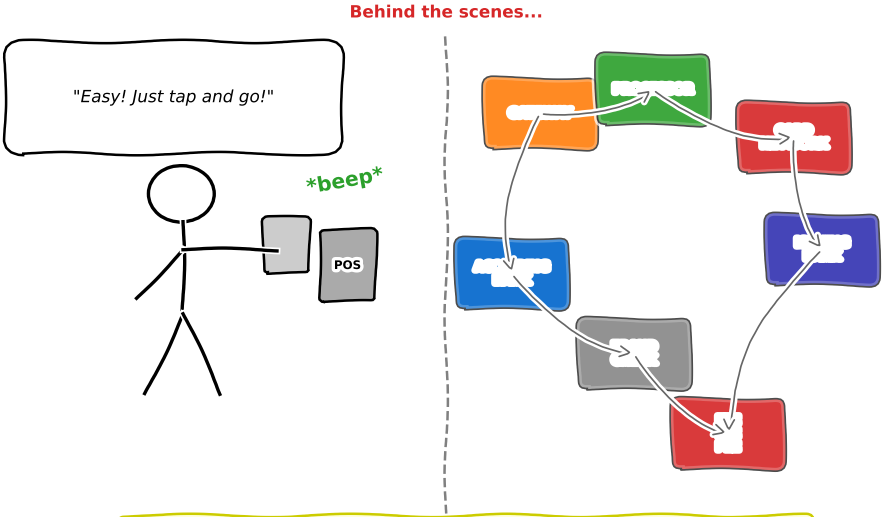
What Really Happens When You Tap to Pay?



Learning Objectives

After completing this lesson, you will be able to:

1. **Trace** the complete journey of a card payment from tap to merchant settlement [Apply]
2. **Identify** the 5–7 intermediaries involved in a single transaction [Understand]
3. **Explain** the difference between authorization and settlement [Understand]
4. **Calculate** the Merchant Discount Rate (MDR) from its component fees [Apply]
5. **Compare** settlement timelines across different payment methods [Analyze]

Bloom's levels covered: Understand, Apply, Analyze

Objectives follow Bloom's taxonomy: Understand → Apply → Analyze.

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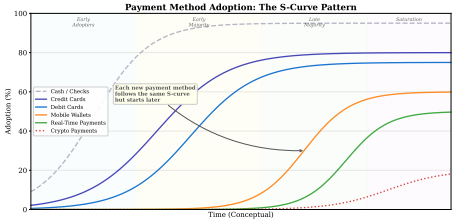
Welcome to Digital Finance

What is this course about?

- How money moves in the 21st century
- The **hidden costs** consumers never see
- Why "free" payments are anything but free
- Technology that is reshaping financial services

Module 1 theme: The Cost Problem

- Every financial transaction has a cost
- Intermediaries extract value at each step
- Understanding cost is the key to understanding disruption



Each new payment method follows an S-curve adoption pattern.

This lesson starts at the beginning: what happens when you tap your card?

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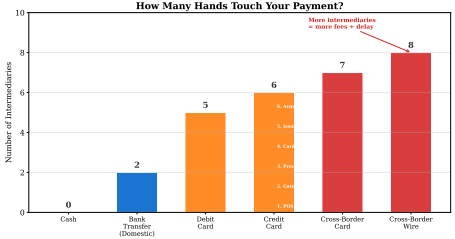
The Illusion of “Free” Payments

What consumers experience:

- Tap phone → Approved → walk away
- No visible fee charged
- Transaction feels instant and costless

What actually happens:

- 5–7 intermediaries process the transaction
- The merchant pays 1.5%–3.5% of the sale
- Settlement takes 1–2 business days
- Fees are **embedded in prices** – consumers pay indirectly



Card fees are invisible to consumers but embedded in every price you pay.

What Is a Payment Value Chain?

Definition: Payment Value Chain

The **payment value chain** is the sequence of intermediaries, processes, and infrastructure required to transfer value from a payer to a payee. Each link in the chain provides a service and extracts a fee.

Key characteristics:

- **Multi-party:** No single entity handles the entire payment
- **Layered fees:** Each intermediary charges for its service
- **Two phases:** Authorization (real-time) and Settlement (batch)
- **Regulated:** Subject to interchange caps, network rules, and banking law

Central question of this lesson: Who are these intermediaries, what do they do, and how much do they charge?

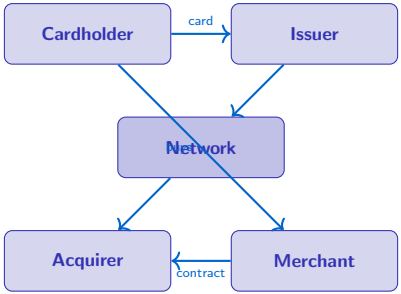
The payment value chain is the foundation for understanding why FinTech disruption targets specific links.

The Four-Party Model

The **four-party model** (also called the "open-loop" model) is the standard architecture for card payments:

1. **Cardholder** — the consumer paying for goods/services
2. **Issuing bank (Issuer)** — the bank that issued the card to the cardholder
3. **Acquiring bank (Acquirer)** — the bank that processes payments for the merchant
4. **Merchant** — the seller receiving the payment

The **card network** (e.g., a major payment network) sits in the middle, routing transactions between issuer and acquirer.



The four-party model separates issuing from acquiring, creating competition on both sides.

Beyond Four Parties: The Real Payment Chain

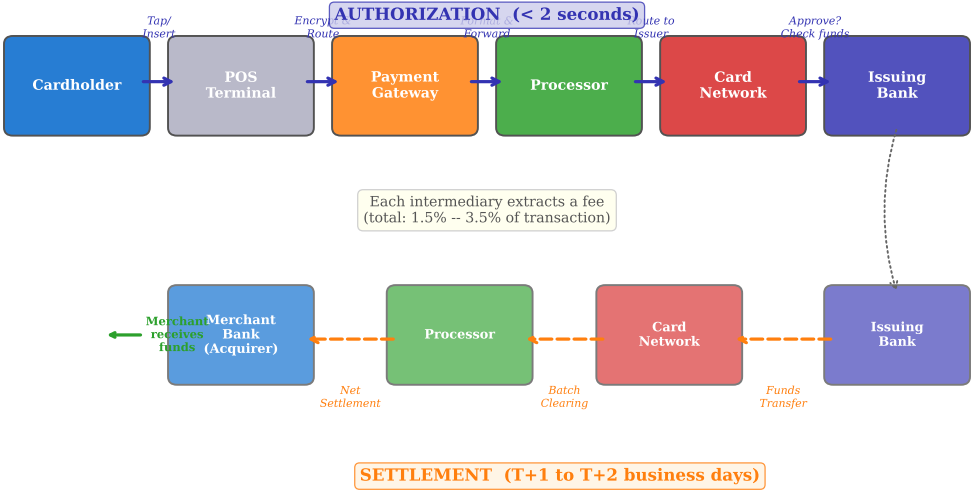
In practice, a modern card payment involves **more than four parties**:

#	Intermediary	Role
1	Point of Sale (POS) Terminal / App	Captures card data, encrypts it
2	Payment Gateway	Routes encrypted data to the processor
3	Payment Processor	Formats the authorization request
4	Card Network	Routes between acquirer and issuer
5	Issuing Bank	Checks funds, fraud screens, approves/declines
6	Acquiring Bank	Settles funds to the merchant
	Cross-border adds:	Correspondent banks, FX providers

Each intermediary extracts a fee. The sum of all fees is the **Merchant Discount Rate (MDR)**.

Cross-border transactions add correspondent banks and FX conversion, increasing both cost and delay.

Anatomy of a Card Payment: Tap to Settlement



What Is Authorization?

Definition: Authorization

Authorization is the real-time process by which the issuing bank approves or declines a transaction. It verifies that the card is valid, the account has sufficient funds, and the transaction does not trigger fraud rules.

Authorization happens in $<$2 seconds:

1. Cardholder taps or inserts card at Point of Sale (POS) terminal
2. POS terminal encrypts card data and sends to payment gateway
3. Gateway forwards to the payment processor
4. Processor routes to the card network
5. Network forwards to the issuing bank
6. Issuer checks: Valid card? Sufficient funds? Fraud risk?
7. Issuer returns approval or decline code
8. Response travels back through the chain to the POS terminal

Authorization is a real-time "question": Can this cardholder pay this amount right now?

What Is Settlement?

Definition: Settlement

Settlement is the batch process by which funds are actually transferred from the cardholder's account, through the network, to the merchant's bank account. It typically occurs T+1 to T+2 business days after the transaction.

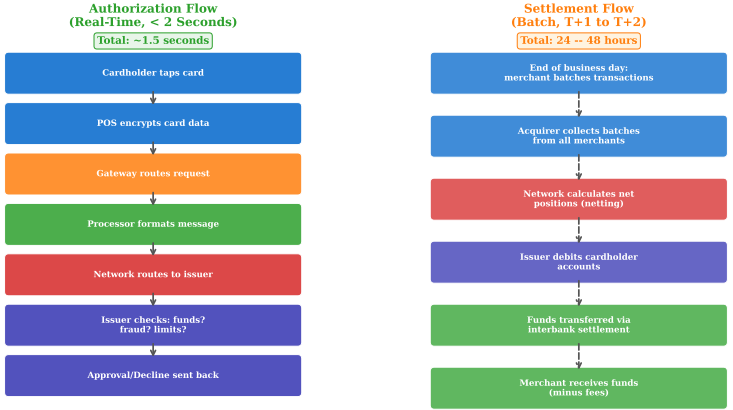
Settlement is a batch process:

1. At end of business day, the merchant "batches" all approved transactions
2. The acquirer collects batches from all its merchants
3. The card network calculates **net positions** (netting) across all participants
4. Issuers debit cardholder accounts
5. Funds are transferred via interbank settlement systems
6. Merchant receives the transaction amount **minus all fees**

Key insight: Authorization is instant; settlement is delayed. The merchant does not receive funds for 1–2 business days.

Batch processing and netting reduce the number of interbank transfers needed.

Authorization vs. Settlement: Two Phases



- **What you see:** Two separate flows — real-time authorization (top, instant yes/no decision) and delayed settlement (bottom, actual fund transfer)
- **Key pattern:** Authorization checks funds and fraud in <2 seconds; settlement batches transactions overnight and nets balances before transfer
- **Takeaway:** The 1–2 day gap between approval and payment receipt creates working capital needs for merchants — a cost that instant systems remove

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What Is Interchange?

Definition: Interchange Fee

The **interchange fee** is a fee paid by the merchant's bank (acquirer) to the cardholder's bank (issuer) for each card transaction. It is the single largest component of the Merchant Discount Rate (MDR), typically 60–70% of the total fee.

Why does interchange exist?

- Compensates the issuer for:
  - Credit risk (cardholder may not repay)
  - Fraud liability (issuer bears fraud losses in many cases)
  - Interest-free period (float cost between purchase and billing)
  - Rewards programs (cashback, miles, points)
- Set by the card network, not negotiated between banks
- Varies by card type, merchant category, and geography

Typical range: 0.2%–0.3% (EU regulated debit) to 2.0%+ (US premium credit)

Interchange is the largest single fee and the primary target of regulatory intervention worldwide.

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What Is the Merchant Discount Rate (MDR)?

Definition: Merchant Discount Rate

The **Merchant Discount Rate (MDR)** is the total percentage fee that a merchant pays on each card transaction. It is the sum of all intermediary fees: interchange + network assessment + processor fee + acquirer markup + gateway fee.

MDR formula:

$$\text{MDR} = \underbrace{\text{Interchange}}_{\text{to Issuer}} + \underbrace{\text{Network Fee}}_{\text{to Card Network}} + \underbrace{\text{Processor Fee}}_{\text{to Processor}} + \underbrace{\text{Acquirer Markup}}_{\text{to Acquirer}} + \underbrace{\text{Gateway Fee}}_{\text{to Gateway}}$$

Worked example (hypothetical numbers):

Component	**Fee**
Interchange (to issuer)	1.80%
Network assessment	0.13%
Processor fee	0.25%
Acquirer markup	0.30%
Gateway fee	0.12%
Total MDR	**2.60%**

On a $100 purchase, the merchant receives $97.40 after the MDR is deducted.

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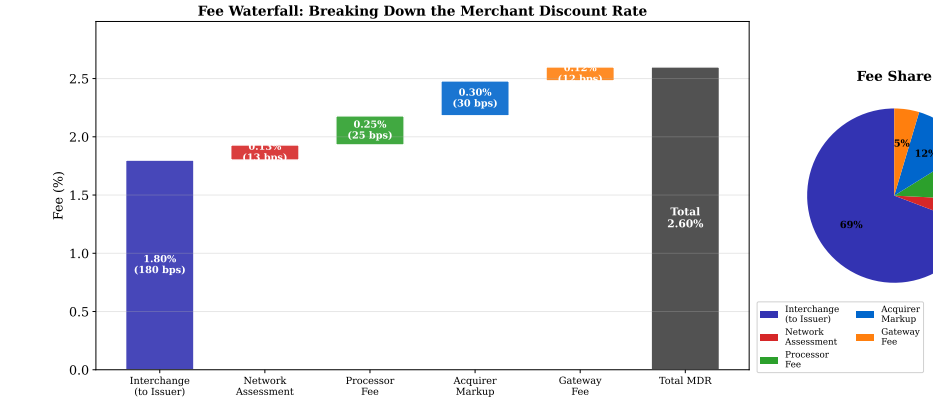
Fee Waterfall: Where Does the Money Go?



- **What you see:** Stacked bar showing MDR components (left panel) and pie chart showing proportions (right panel) — interchange is the tallest segment
- **Key pattern:** Interchange captures 1.80% out of 2.60% total MDR — roughly 70% of the fee goes to the issuing bank
- **Takeaway:** Regulation targets interchange because it is the largest and least competitive component — set by networks, not negotiated

Interchange dominates the fee stack — typically 65–70% of the total MDR.

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MDR Calculation: Practice

Scenario: A coffee shop processes a $5.00 contactless debit transaction.

Fee Component	Rate
Interchange	0.50% + $0.10 fixed
Network assessment	0.04%
Processor fee	$0.08 fixed
Acquirer markup	0.15%
Gateway fee	$0.03 fixed

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MDR Calculation: Practice

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Gateway fee	$0.03 fixed

Solution:

- Interchange: $\$5.00 \times 0.50\% + \$0.10 = \$0.025 + \$0.10 = \mathbf{\$0.125}$
- Network: $\$5.00 \times 0.04\% = \mathbf{\$0.002}$
- Processor: **$0.08**
- Acquirer: $\$5.00 \times 0.15\% = \mathbf{\$0.0075}$
- Gateway: **$0.03**
- **Total: $0.2445 ($\approx$ $0.24) $\rightarrow$ Effective MDR: 4.89%**

Small transactions suffer disproportionately from fixed per-transaction fees — the "small ticket problem."

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The Small-Ticket Problem

Fixed fees hit small transactions hardest:

Transaction	Total Fee	Effective MDR	Impact
$2.00 (vending)	$0.22	11.0%	Severe
$5.00 (coffee)	$0.24	4.89%	High
$25.00 (lunch)	$0.44	1.8%	Moderate
$100.00 (groceries)	$0.93	0.9%	Low
$500.00 (electronics)	$3.75	0.8%	Low

This is why:

- Some small merchants still prefer cash for small purchases
- Real-time transfer networks (no per-transaction fixed fee) are attractive for micro-payments
- Payment innovation often targets the **bottom of the market** first

The fixed-fee component creates a regressive cost structure that disadvantages small merchants and small transactions.

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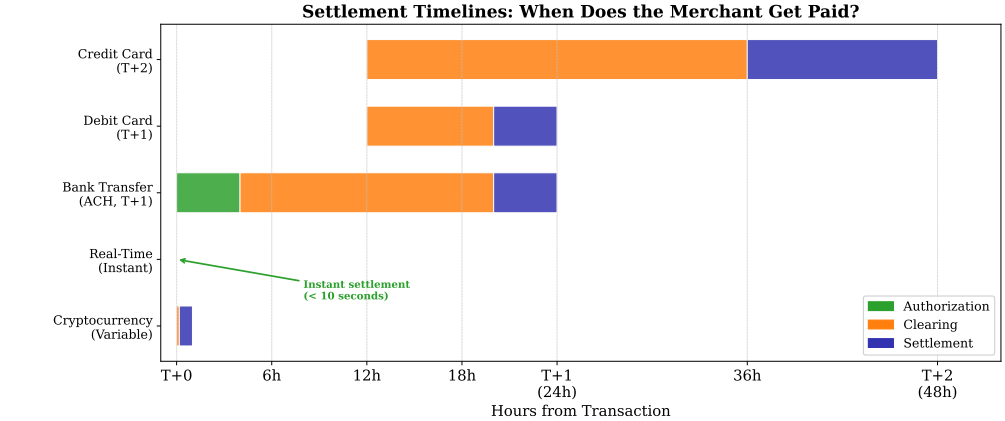
Settlement Timelines: When Does the Merchant Get Paid?



- **What you see:** Horizontal Gantt bars showing authorization (green), clearing (orange), and settlement (purple) phases across 5 payment methods on a 0–48 hour timeline
- **Key pattern:** Credit cards take 48 hours (T+2), debit takes 24 hours (T+1), but real-time systems settle in $<$10 seconds — a 10,000x speed difference
- **Takeaway:** Delayed settlement ties up merchant working capital — instant systems eliminate this hidden cost and improve cash flow

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Understanding T+1 and T+2 Settlement

Definition: T+N Settlement

T+N means the transaction settles N **business days** after the transaction date (T). T+0 means same-day settlement. T+1 means next business day. T+2 means two business days later.

Why does settlement take so long?

- **Batch processing:** Transactions are grouped and processed together for efficiency
- **Netting:** Networks calculate net amounts owed between banks to minimize transfers
- **Risk management:** Delay allows time for fraud detection and chargebacks
- **Banking hours:** Interbank transfers only occur during business hours
- **Legacy infrastructure:** Many systems were designed decades ago

The cost of delay: For a merchant doing $10,000/day in card sales, T+2 settlement means $20,000 is always "in the pipeline" — unavailable working capital.

Delayed settlement creates a hidden cost: the opportunity cost of locked-up working capital.

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Batch Processing and Netting

Why batch instead of real-time?

- Processing each transaction individually would require millions of interbank transfers daily
- **Netting** reduces this dramatically

Example of bilateral netting:

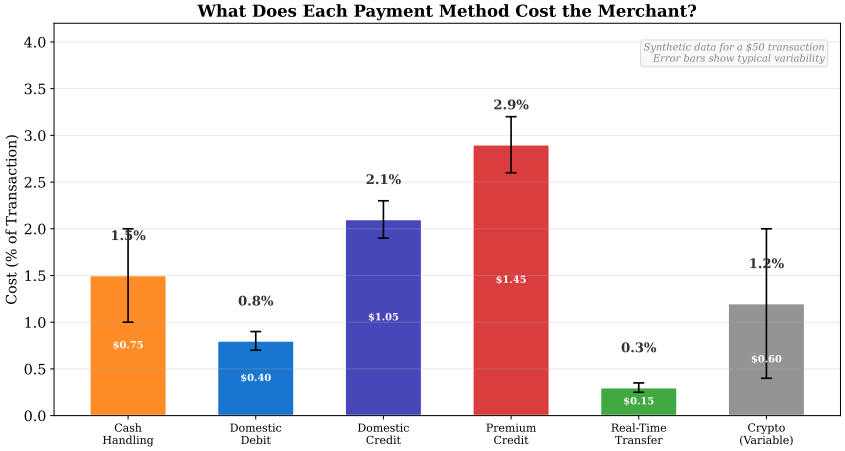
Flow	**Gross**	**Net**
Bank A owes Bank B	\$1,200,000	
Bank B owes Bank A	\$950,000	
Net transfer: A $\rightarrow$ B		**\$250,000**

Instead of two transfers totaling \$2,150,000, one transfer of \$250,000 settles the same obligations.

- **Multilateral netting:** Card networks net across *all* participating banks simultaneously
- Reduces settlement risk and operational cost
- But introduces **delay** — the trade-off this entire module explores

Netting is efficient for the system but costly for individual merchants who need cash flow.

Cost Comparison: What Does Each Method Cost the Merchant?



- Cash has hidden costs: counting, storage, theft risk, armored transport
- Real-time transfers are cheapest but lack chargeback protection
- Credit cards are expensive but offer consumer protections and rewards

No payment method is truly "free" — every method has a cost structure, visible or hidden.

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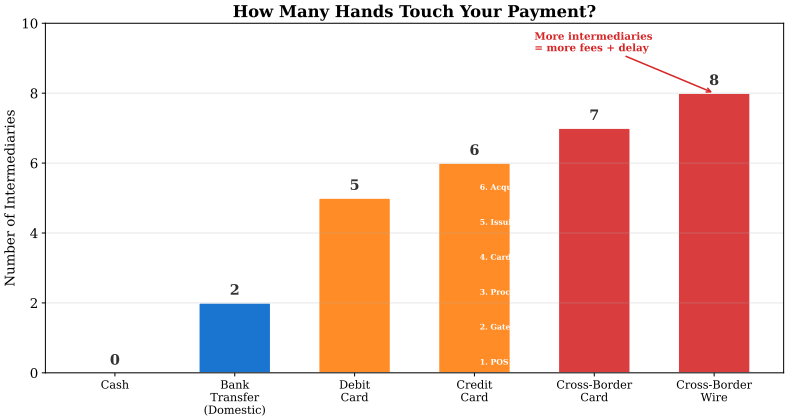
How Many Intermediaries Touch Your Payment?



- **What you see:** Bar chart showing intermediary count increasing from 3 (P2P) to 4 (domestic card) to 7–10 (cross-border card)
- **Key pattern:** Each additional intermediary extracts a fee and adds delay — cross-border payments have 2–3x more links than domestic
- **Takeaway:** Payment cost and settlement time grow with chain length — FinTechs attack by removing intermediaries or replacing them with cheaper tech

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Cross-Border Payments: Extra Complexity

When a payment crosses borders, **additional intermediaries** enter the chain:

#	Additional Intermediary	Added Cost
7	Correspondent bank (sender side)	0.1%–0.5%
8	Correspondent bank (receiver side)	0.1%–0.5%
9	FX conversion provider	0.5%–3.0%
10	Compliance / Anti-Money Laundering (AML) screening	Flat fee

Result:

- Total cost: 3%–7% for a cross-border consumer card payment
- Settlement: T+3 to T+5 (or longer for exotic corridors)
- Transparency: Sender often does not know the total fee until after the fact

This is why cross-border payments are a primary target for FinTech disruption.

The G20 has set a target of reducing cross-border payment costs and increasing speed.

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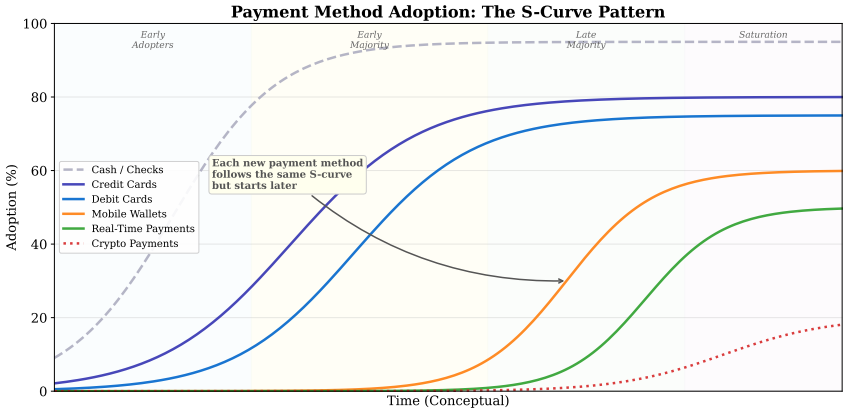
Payment Innovation Follows the S-Curve



- New payment methods do not replace old ones overnight
- Each follows the same adoption pattern: innovators → early majority → saturation
- Real-time payments and mobile wallets are currently in the **early majority** phase

Understanding where a payment method sits on the S-curve helps predict disruption timing.

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Regulatory Context: Interchange Caps

Why do regulators care about interchange?

- Interchange is the largest fee component and is **set by the network**, not by market competition
- Merchants cannot negotiate interchange — they can only accept or reject a card network entirely
- Consumers bear the cost indirectly through higher prices

Regulatory responses:

Jurisdiction	Cap (Debit)	Cap (Credit)
European Union (Interchange Fee Regulation, IFR)	0.20%	0.30%
Australia (RBA)	0.08 AUD flat	0.30% (weighted avg.)
United States (Durbin)	0.05% + \$0.21 (debit)	No cap (credit)
India (RBI)	0% (UPI)	MDR capped

Key debate: Do interchange caps lower prices for consumers, or do they reduce card rewards and bank revenue?

Interchange regulation is one of the most debated topics in payment policy worldwide.

Who Wins and Who Loses in the Payment Value Chain?

Party	Wins	Loses
Consumer	Convenience, rewards, fraud protection	Pays indirectly via higher prices
Merchant	Access to card-paying customers	Pays MDR (1.5%–3.5%)
Issuer	Interchange revenue, interest income	Credit risk, fraud liability
Acquirer	Markup revenue, merchant relationships	Competitive pressure, thin margins
Network	Assessment fees, network effects	Regulatory risk, competition
Processor	Per-transaction fees, scale economies	Commoditization pressure

FinTech disruption targets the links with the fattest margins and weakest customer loyalty.

Understanding each party's incentives explains why disruption targets specific links in the chain.

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Where FinTech Attacks the Payment Value Chain

Link Targeted	FinTech Approach	Lessons Ahead
Gateway / Processor	Integrated payment platforms	M1L2–L3
Card Network	Real-time payment rails	M1L4
Issuer	Neobanks, virtual cards	M1L5
Cross-border	Blockchain, stablecoins	M3
Entire chain	Peer-to-peer (P2P) payments	M1L3

The pattern:

- FinTechs attack by **removing intermediaries** (disintermediation)
- Or by **replacing expensive intermediaries** with cheaper technology
- Or by **bundling multiple roles** into one platform (vertical integration)

Every subsequent lesson in this module examines a specific attack vector on the payment value chain.

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One Last Thought...

"Free" just means someone else is paying—and that someone is embedding it in your prices.

Sometimes the best way to remember a concept is to laugh about it.

Key Takeaways

1. A single card payment touches **5–7 intermediaries**, each extracting a fee
2. The **Merchant Discount Rate (MDR)** is the sum of interchange, network, processor, acquirer, and gateway fees
3. **Interchange** is the largest fee component (60–70% of MDR) and is set by the card network
4. **Authorization** is real-time ($<$2 seconds); **settlement** is batch (T+1 to T+2)
5. **Fixed per-transaction fees** disproportionately impact small transactions (the "small-ticket problem")
6. **Cross-border payments** add correspondent banks and FX, increasing cost to 3%–7%
7. **FinTech disruption** targets specific links in the payment value chain

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Understanding the anatomy of a payment is the foundation for the entire "Cost Problem" module.

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Summary / Next Lesson Preview

This lesson: We traced a card payment end-to-end, identified every intermediary, and calculated the total cost the merchant pays.

Key vocabulary:

- Payment value chain
- Four-party model
- Interchange fee
- Merchant Discount Rate (MDR)
- Authorization vs. settlement
- Batch processing / netting
- T+1 / T+2 settlement
- Small-ticket problem

Next lesson (M1L2): *The Fee Stack* — We will quantify exactly how much each intermediary charges, examine pricing models (interchange-plus, flat-rate, tiered), and analyze how FinTech payment platforms compete on price.

Review: Can you trace all 6 intermediaries in a credit card payment and name the fee each charges?

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Self-Check #1: Anatomy of a Payment

Attempt these before turning the page.

1. [Understand] Name the four parties in the four-party model and describe what each earns on a \$50 card swipe.
2. [Apply] A merchant takes a \$200 card payment. Interchange is 1.8 % + \$0.10, network fee 0.04 %, processor 0.15 % + \$0.08. Compute the blended MDR (effective %).
3. [Analyze] Why do coffee shops often discourage card payments under \$5, but airlines happily accept them? Explain using the fixed-fee drag argument.

Solutions hidden unless `\solutionstrue` is set before compiling.